

# SCXI™

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## **SCXI-1190/1191 User Manual**

## **Worldwide Technical Support and Product Information**

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# Compliance

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## FCC/Canada Radio Frequency Interference Compliance\*

### Determining FCC Class

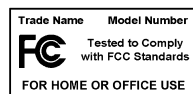
The Federal Communications Commission (FCC) has rules to protect wireless communications from interference. The FCC places digital electronics into two classes. These classes are known as Class A (for use in industrial-commercial locations only) or Class B (for use in residential or commercial locations). Depending on where it is operated, this product could be subject to restrictions in the FCC rules. (In Canada, the Department of Communications (DOC), of Industry Canada, regulates wireless interference in much the same way.)

Digital electronics emit weak signals during normal operation that can affect radio, television, or other wireless products. By examining the product you purchased, you can determine the FCC Class and therefore which of the two FCC/DOC Warnings apply in the following sections. (Some products may not be labeled at all for FCC; if so, the reader should then assume these are Class A devices.)

FCC Class A products only display a simple warning statement of one paragraph in length regarding interference and undesired operation. Most of our products are FCC Class A. The FCC rules have restrictions regarding the locations where FCC Class A products can be operated.

FCC Class B products display either a FCC ID code, starting with the letters **EXN**, or the FCC Class B compliance mark that appears as shown here on the right.

Consult the FCC web site <http://www.fcc.gov> for more information.



### FCC/DOC Warnings

This equipment generates and uses radio frequency energy and, if not installed and used in strict accordance with the instructions in this manual and the CE Mark Declaration of Conformity\*\*, may cause interference to radio and television reception. Classification requirements are the same for the Federal Communications Commission (FCC) and the Canadian Department of Communications (DOC).

Changes or modifications not expressly approved by National Instruments could void the user's authority to operate the equipment under the FCC Rules.

### Class A

#### Federal Communications Commission

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

#### Canadian Department of Communications

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

### Class B

#### Federal Communications Commission

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

## **Canadian Department of Communications**

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

## **European Union - Compliance to EEC Directives**

Readers in the EU/EEC/EEA must refer to the Manufacturer's Declaration of Conformity (DoC) for information\*\* pertaining to the CE Mark compliance scheme. The Manufacturer includes a DoC for most every hardware product except for those bought for OEMs, if also available from an original manufacturer that also markets in the EU, or where compliance is not required as for electrically benign apparatus or cables.

\* Certain exemptions may apply in the USA, see FCC Rules §15.103 **Exempted devices**, and §15.105(c). Also available in sections of CFR 47.

\*\* The CE Mark Declaration of Conformity will contain important supplementary information and instructions for the user or installer.

# Conventions

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The following conventions are used in this manual:



This icon denotes a note, which alerts you to important information.



This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.



This icon denotes a warning, which advises you of precautions to take to avoid being electrically shocked.

**bold**

Bold text denotes items that you must select or click on in the software, such as menu items and dialog box options. Bold text also denotes parameter names.

*italic*

Italic text denotes variables, emphasis, a cross reference, or an introduction to a key concept. This font also denotes text that is a placeholder for a word or value that you must supply.

monospace

Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames and extensions, and code excerpts.

**monospace bold**

Bold text in this font denotes the messages and responses that the computer automatically prints to the screen. This font also emphasizes lines of code that are different from the other examples.

SCXI-119X

Refers to the both the SCXI-1190 module and the SCXI-1191 module.

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# Installing and Configuring the SCXI-119X

This manual describes the electrical and mechanical characteristics of the SCXI-1190 (quad  $1 \times 4$ ,  $50 \Omega$ , 1.3 GHz bandwidth) and the SCXI-1191 (quad  $1 \times 4$ ,  $50 \Omega$ , 4 GHz bandwidth) multiplexer modules for the SCXI bus and contains information concerning their installation and operation.

## About the SCXI-119X

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This section summarizes the features and operation of the SCXI-119X switch modules. In addition, refer to Appendix A, *Specifications*, for detailed specifications of the switch module.

The SCXI-119X modules are general-purpose, quad 4-channel, high-bandwidth multiplexing switches. The SCXI-119X uses single-pole double-throw, high-bandwidth relays capable of switching signals from DC to 1.3 GHz bandwidth (SCXI-1190) and from DC to 4 GHz bandwidth (SCXI-1191). The characteristic impedance of the channels is  $50 \Omega$ . For the SCXI-1190, the maximum rated voltage of the switch is 24 VDC, and the maximum rated current is 1 A at 24 V. For the SCXI-1191, the maximum rated voltage of the switch is 30 VDC, and the maximum rated current is  $30 V_{\text{rms}}$  at 0.33 ADC.

## Installing the Software

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You can control the SCXI-119X programmatically in an application development environment (ADE) using NI-SWITCH. The supported ADEs include LabVIEW, LabWindows/CVI, Visual Basic, and C or C++ environments. The following steps describe how to install your SCXI-119X software.

1. Install your ADE if you have not already done so. Refer to your ADEs documentation for the software installation instructions.

2. Install the NI-SWITCH software that came on a CD with your SCXI-119X. The CD includes the software required to configure and to program your SCXI-119X module.
  - a. Insert your National Instruments NI-SWITCH software CD into the CD-ROM drive.
  - b. Click **Install** in the installation window that will appear automatically.



**Note** If the installation window does not appear, double-click the **My Computer** icon on your PC desktop. Find the CD drive, and double-click it. In the CD directory, double-click `install.exe`.

## Installing the Hardware

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The following section describes how to unpack, install, and connect your SCXI-119X for use with an SCXI chassis.



**Caution** Make sure you read and understand all the safety information in this manual before you install an SCXI module.

## Unpacking

Your SCXI-119X module is shipped in an antistatic package to prevent electrostatic discharge damage to the module. Electrostatic discharge can damage several components on the module. To avoid damaging the module, take the following precautions:

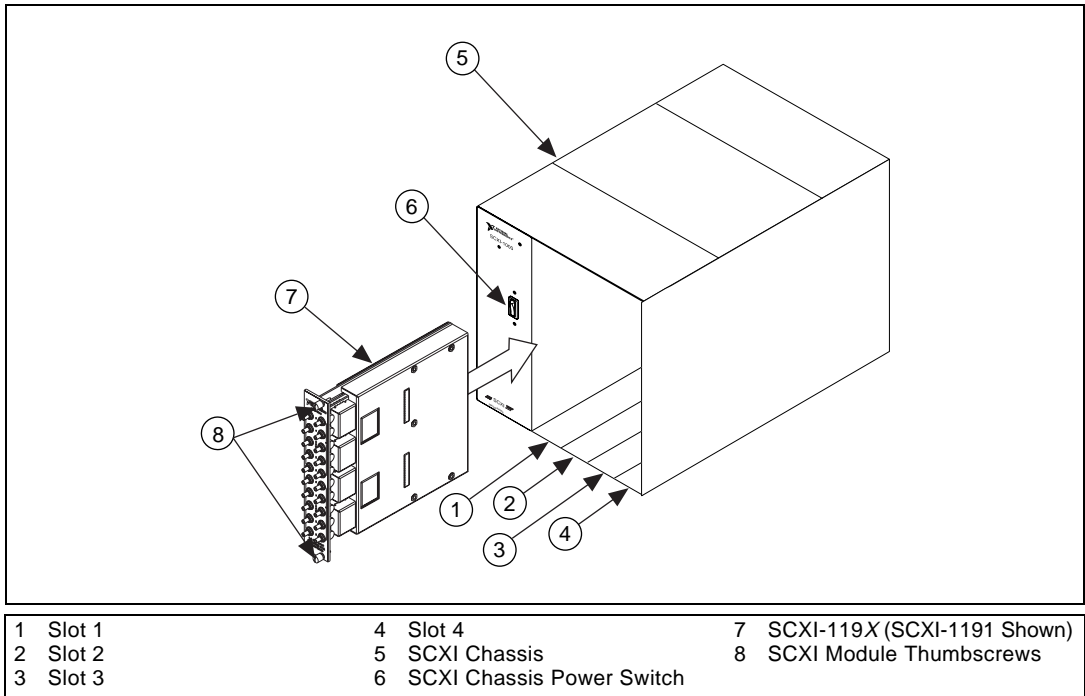
- Ground yourself through a grounding strap or by holding a grounded object.
- Touch the antistatic package to a metal part of your SCXI chassis before removing the module from the package.
- Remove the module from the package, and inspect the module for loose components or any other sign of damage. Notify National Instruments if the module appears damaged in any way. *Do not* install a damaged module into your SCXI chassis.
- *Never* touch the exposed pins of connectors to avoid possible electrostatic discharge.

## Installing the SCXI-119X Module into an SCXI Chassis

You need the following items to complete the installation:

- SCXI-119X module
- SCXI chassis

Follow these steps to install your SCXI-119X module into an SCXI chassis while referring to Figure 1-1.



**Figure 1-1.** Installing the SCXI-119X into an SCXI Chassis

1. Turn off the computer that contains the DAQ device or computer-based instrument, or disconnect the computer from your SCXI chassis.
2. Turn off the SCXI chassis.



**Caution** Do *not* insert the SCXI-119X module into a chassis that is turned on as doing so could damage the module.

3. Remove the protective plastic caps from the module's thumbscrews so that the module will insert correctly.

4. Insert the SCXI-119X module into slot 1. Gently guide the module into the module guides and push it to the back of the slot until the connectors make good contact. The module must be firmly engaged; however, *do not* force the module into place. If the module is not sliding easily into the chassis, check for correct insertion into the module guides.



**Note** When installing the SCXI-119X module in an SCXI chassis, slot 1 should be filled first, then fill slot 2 with the next SCXI-119X.

5. Insert any other SCXI modules into the remaining slots in the same manner as described in step 4.
6. Secure all the SCXI-119X modules to the SCXI chassis by tightening both module thumbscrews.

## Connecting the SCXI-119X to a DAQ Device or Computer-Based Instrument

You need the following items:

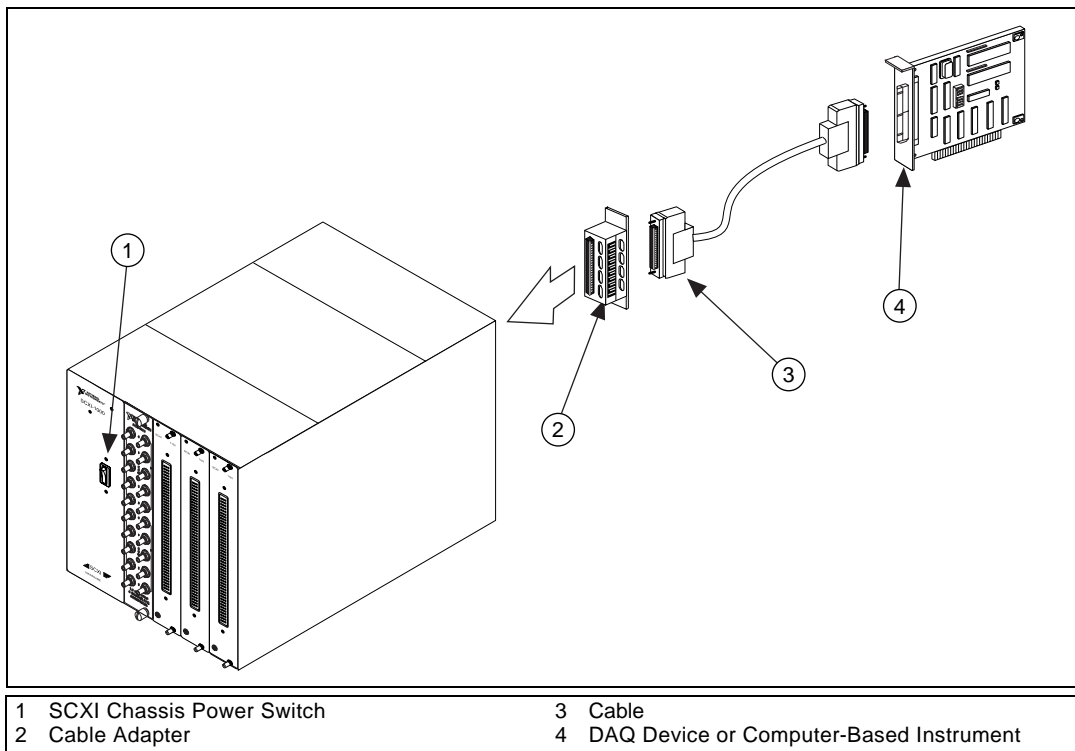
- SCXI chassis with the SCXI modules installed (Refer to the [Installing the SCXI-119X Module into an SCXI Chassis](#) section.)
- SCXI cable assembly, which consists of a cable adapter and a cable
- An installed National Instruments DAQ device or computer-based instrument that is able to control the SCXI chassis such as the NI 4060
- 1/4 in. flathead screwdriver

Consult your SCXI chassis documentation, other SCXI module documentation, and DAQ device or computer-based instrument documentation for additional instructions and warnings. Your SCXI-119X module and any other SCXI modules should already be installed in the chassis according to their installation instructions.

You must select one of the modules in the chassis to be the cabled module—the module to which the SCXI cable assembly will be connected. If the chassis contains at least one SCXI-1140 module, select an SCXI-1140 as the cabled module; otherwise, select one of the remaining modules.

To connect the chassis to a DAQ device for multiplexed operation, complete the following steps while referring to Figure 1-2:

1. Turn off both the SCXI chassis and the computer that contains the DAQ device or computer-based instrument.
2. Insert the cable adapter into the back of the SCXI chassis aligned with the module that is to be connected to the DAQ device or computer-based instrument. See your cable assembly's installation guide for more specific information.
3. Connect the cable to the back of the cable adapter, ensuring that the cable fits securely.
4. Connect the other end of the cable to the DAQ device or computer-based instrument that you will use to control the SCXI system.
5. Check the cable installation, making sure the connectors are securely fastened at both ends.
6. Turn on the SCXI chassis.
7. Turn on the computer.
8. If you have already installed the appropriate software, you are ready to configure the SCXI-119X. If you have not installed the appropriate software, refer to the [Installing the Software](#) section.



**Figure 1-2.** Connecting an SCXI Chassis to a DAQ Device or Computer-Based Instrument

## Connecting the SCXI-119X to a DAQ Device in a PXI Combination Chassis

To connect the SCXI-119X to a DAQ device in a PXI combination chassis, such as the PXI-1010 or PXI-1011, you need the following items:

- PXI combination chassis with the SCXI modules installed
- National Instruments PXI MIO DAQ device, or a computer-based instrument that is capable of controlling SCXI, installed in the right most slot of the PXI section of the combination chassis

A PXI combination chassis can use both SCXI and PXI modules at the same time. Because the connection between the SCXI backplane and the PXI backplane is made through a local bus interface to a PXI multifunction I/O module installed in the right most slot, no external cabling is needed to connect one PXI multifunction I/O module to the SCXI bus.

You should have already installed your SCXI-119X module and any other SCXI modules in the chassis according to their installation instructions. To use the SCXI-119X module with a DAQ device or computer-based instrument in a PXI combination chassis, turn on the SCXI chassis.

Consult your PXI chassis documentation, other SCXI module documentation, and DAQ device or computer-based instrument documentation for additional instructions and warnings.

If you have already installed the appropriate software, you are ready to configure the SCXI-119X. If you have not installed the appropriate software, refer to the *Installing the Software* section.

## Configuration and Self-Test

---

NI-SWITCH installed the **Measurement & Automation Explorer** icon on your PC desktop. This utility allows you to configure and test your National Instruments hardware.

Follow these steps to configure your SCXI system:

1. Double-click the **Measurement & Automation Explorer** icon on your PC desktop. Click the + next to **Devices and Interfaces**.  
If you are adding new modules to an existing chassis, go to step 4.  
If you are inserting modules into an empty chassis, go to step 2.
2. Add a new chassis to the configured devices and interfaces by right-clicking on **Devices and Interfaces** and selecting **Insert**. Select the appropriate chassis from the list box and click **OK**.
3. Configure the chassis.
  - a. Select a **Chassis ID**. The ID is an integer value you choose to uniquely identify the chassis for programming and scanning.
  - b. Select the **Chassis Address**. This selection is needed to address the chassis in a multichassis SCXI system. Unless you are using multiple chassis with the same DAQ device or computer-based instrument, select a chassis address of zero, which is the factory-default setting of all SCXI chassis. If you are using multiple chassis, refer to your SCXI chassis user manual for further information.
  - c. For remote SCXI chassis, such as the SCXI 2000 or a SCXI chassis using SCXI 2400 modules, you also need to select the **Baud Rate** and **COM Port**.
  - d. After completing the chassis configuration, click **Next**.

You now have the choice of automatically detecting which modules are installed in the chassis or manually adding them.

- If you have just added the chassis to **Devices and Interfaces**, you can automatically detect new modules.
- If the chassis was already listed in **Devices and Interfaces**, you must manually add new modules.

Go to the appropriate section that follows to continue the software configuration of your chassis.

If you need further help during the configuration process, open *Measurement & Automation Help* by selecting **Help»Help Topics** in your Measurement & Automation Explorer window.

## Auto-Detecting Modules

If you selected auto-detect, you must have your chassis connected to your DAQ device or computer-based instrument, except in the case of a remote chassis, which you should connect to the computer using a serial port cable.

Before auto-detecting modules, refer to the [Connecting the SCXI-119X to a DAQ Device or Computer-Based Instrument](#) section.

To auto-detect your SCXI module(s), follow these steps:

1. Make sure the chassis power is turned on.
2. In the auto-detect window, select **Yes** under **Auto-Detect Modules?** and click **Next**. If your chassis is a remote SCXI chassis, go to step 5, otherwise go to step 3.
3. Select your communication path, which is the device in your PC or PXI system directly connected to the chassis, and click **Next**.
4. When the modules are detected, select the module that is connected to your communication device by the cable.
5. Click **Finish**.

Measurement & Automation Explorer should now recognize your SCXI chassis and SCXI module(s). If the software did not recognize your modules, check your cable connections and retry auto-detecting. Alternatively, try installing the modules manually before taking the troubleshooting measures discussed in the [Troubleshooting Self-Test Verification](#) section.





**Note** If the Measurement & Automation Explorer recognized any module as an SCXI custom module, you may be using an old version of NI-DAQ, the data acquisition driver software. You can download the latest version of NI-DAQ for free at [www.ni.com](http://www.ni.com).

## Manually Adding Modules

If you did not auto-detect your SCXI modules, you must add each of your modules separately. Use the following steps to manually add modules:

1. In the auto-detect window, select **No** under **Auto-Detect Modules?** and click **Finish**.
2. Display the list of devices and interfaces by clicking the + next to **Devices and Interfaces**.
3. The chassis you added is now displayed in the list. Display the list of modules in the chassis by clicking the + next to the Chassis name.
4. Right-click on the appropriate physical installation slot and select **Insert**.



**Note** When looking at the front of the SCXI chassis, slot 1 is the left most slot.

5. Select the module installed in that slot and click **Next**.



**Note** If the appropriate module name does not appear on the list, you may be using an old version of NI-DAQ, the data acquisition driver software. You can download the latest version of NI-DAQ for free at [www.ni.com](http://www.ni.com).

6. Configure your module as follows:
  - If the selected module is physically connected to a National Instruments DAQ device or computer-based instrument, select that device by using the **Connected to** control. If you want this device to control the chassis, confirm that the checkbox labeled **This device will control the chassis** is checked.
  - If the selected module is not connected to a National Instruments DAQ device or computer-based instrument, select **none**.
  - In the **Operating Mode** box, select **Multiplexed Mode**.
7. Click **Finish**.

If you need to manually install more SCXI-119X modules in your chassis, repeat steps 3 through 6 to configure each module.

Your SCXI chassis and SCXI module(s) should now be configured properly. If your configuration is complete, test the system as described in the *Self-Test Verification* section to ensure that your SCXI system is communicating properly with the device.

## Self-Test Verification

To test the successful configuration of your system, complete the following steps:

1. Double-click the **Measurement & Automation Explorer** icon on your PC desktop:
2. Verify that the chassis power is on and that the chassis is correctly connected to a DAQ device or computer-based instrument.
3. Display the list of devices and interfaces by clicking the + next to **Devices and Interfaces**.
4. From the list that appears, locate the chassis you want to test. Right-click on the chassis and select **Test**.
5. If the communication test is successful, a message **The chassis has been verified** appears. Click **OK**. If the communication test is unsuccessful, refer to the *Troubleshooting Self-Test Verification* section.

Your SCXI system should now operate properly with your ADE software. If you experience problems between your SCXI system and your ADE, refer to the *Troubleshooting Self-Test Verification* section. Additionally, you may find it helpful to refer to your NI-SWITCH documentation, your ADE software documentation, and your chassis documentation. National Instruments documentation is available to download free at [www.ni.com/manuals](http://www.ni.com/manuals).

## Troubleshooting Self-Test Verification

If the preceding test did not verify your chassis configuration, take the following steps to successfully complete system configuration:

1. If you get the warning message **Unable to test chassis at this time**, probably you have not designated at least one module as connected to a DAQ device or computer-based instrument. Take the following troubleshooting actions:
  - a. Double-click the **Measurement & Automation Explorer** icon on your PC desktop.
  - b. Click the + next to **Devices and Interfaces**.

- c. Click the + next to your SCXI chassis to show all the SCXI modules.
  - d. Right-click on the module that is connected to your DAQ device or computer-based instrument and select **Properties**.
  - e. Change the **Connected to** selection from **None** to **Connected to: Device x**.
2. If you get the warning message **Failed to find** followed by the module codes and the message **Unable to communicate with chassis**, take the following troubleshooting actions:
  - a. Make sure that the SCXI chassis is powered on.
  - b. Make sure the cable between the SCXI chassis and DAQ device or computer-based instrument is properly connected.
  - c. Inspect the cable and the connectors for any bent pins.
  - d. Make sure you are using the correct National Instruments cable assembly.
  - e. Test your DAQ device or computer-based instrument to verify it is working properly. See your DAQ device or computer-based instrument user manual for more information.
3. If you get the warning message **Failed to find**, followed by module codes and then the message **Instead found: module with ID 0Xxx**, return to the [Connecting the SCXI-119X to a DAQ Device or Computer-Based Instrument](#) section and make sure the correct module is in the specified slot. Delete the incorrect module as described in the [Removing the SCXI-119X from an SCXI Chassis](#) section and then add the correct module as described in the [Manually Adding Modules](#) section.
4. If you get the warning message **Failed to find**, followed by a module code and then the message **Slot x is empty**, check to see if the configured module is installed in the specified slot. If not, install the module by referring to the [Installing the Hardware](#) section. If the module is installed in the correct slot, turn off the chassis, remove the module as specified in the [Removing the SCXI-119X from an SCXI Chassis](#) section, and verify that no connector pins are bent on the rear signal connector. Reinstall the module, ensuring the module is fully inserted and properly aligned in the slot.
5. After checking the preceding items, return to the [Self-Test Verification](#) section and retest your SCXI chassis.

## Removing the SCXI-119X

---

This section describes how to remove the SCXI-119X from an SCXI chassis.

### Removing the SCXI-119X from an SCXI Chassis

Make sure you read and understand all the safety information in this manual before you remove an SCXI module. You need the following items to complete this task:

- SCXI chassis with the SCXI-119X module(s) installed
- 1/4 in. flathead screwdriver

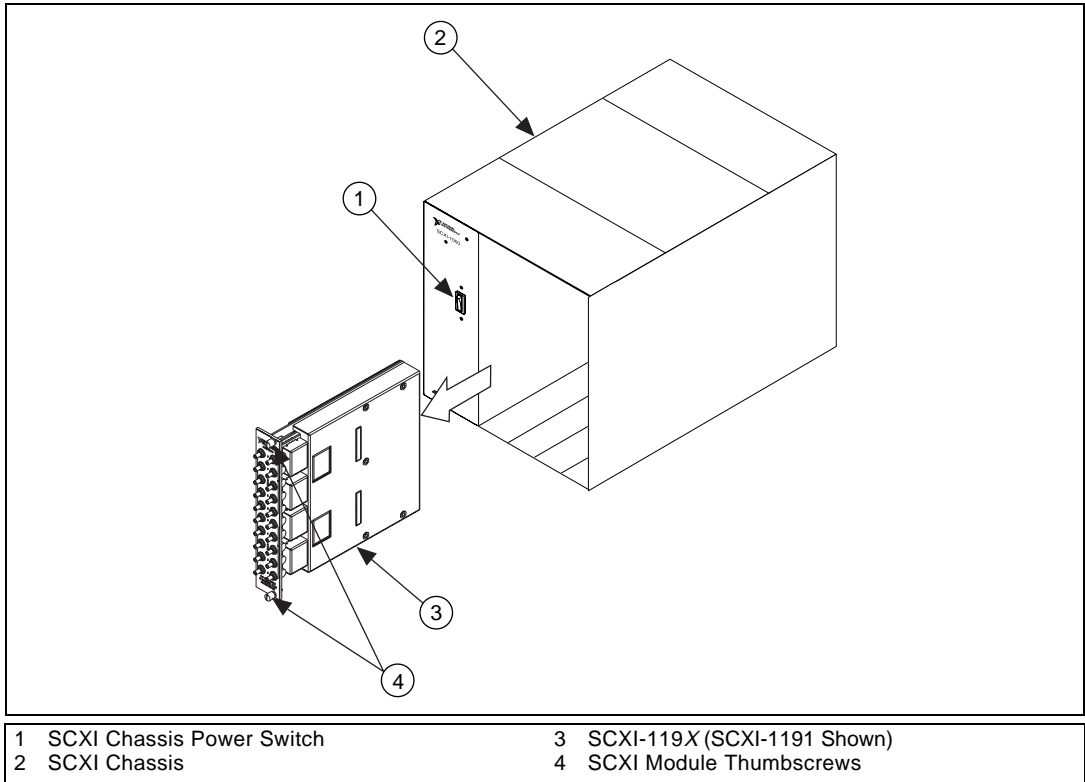
Consult the documentation for your SCXI or PXI (if you are using a combination chassis) chassis and accessories for additional instructions and warnings. To remove the SCXI-119X module from an SCXI chassis, follow these steps while referring to Figure 1-3:

1. Remove all signals connected to the SCXI-119X.
2. Turn off the SCXI chassis power.



**Caution** Do *not* remove the SCXI-119X module from a chassis that is turned on as doing so could damage the module.

3. Rotate the thumbscrews securing the SCXI-119X to the chassis counter-clockwise until they are loose, but do not completely remove the thumbscrews.
4. Remove the SCXI-119X by pulling steadily on both thumbscrews until the module slides completely out.



**Figure 1-3.** Removing the SCXI-119X

## Removing the SCXI-119X from Measurement & Automation Explorer

To remove a module from Measurement & Automation Explorer, complete the following steps:

1. Double-click the **Measurement & Automation Explorer** icon on your PC desktop.
2. Display the list of installed devices and interfaces by clicking the + next to **Devices and Interfaces**.
3. Locate the chassis in the list of installed devices. Display the list of modules in the chassis by clicking the + next to **Chassis**.
4. Right-click on the module or chassis you want to delete and select **Delete**.
5. You will be presented a confirmation window. Click **Yes** to continue deleting the module or chassis or **No** to cancel this action.



**Note** Deleting an SCXI chassis deletes all modules in the chassis. All configuration information for these modules is also lost.

Your SCXI chassis and/or SCXI module(s) should now be removed from the list of installed devices in Measurement & Automation Explorer.

---

# Using the SCXI-119X

This chapter contains a functional overview, safety instructions, and connection possibilities of the SCXI-119X multiplexer module.

## Functional Overview

---

The SCXI-119X modules are general-purpose, quad 4-channel, high-bandwidth multiplexing switches. The SCXI-1190 uses single-pole double-throw, high-bandwidth relays capable of switching signals from DC to 1.3 GHz. Functionally identical, the SCXI-1191 has a bandwidth of DC to 4 GHz. Figure 2-1 illustrates the key functional components of the SCXI-119X multiplexer module.

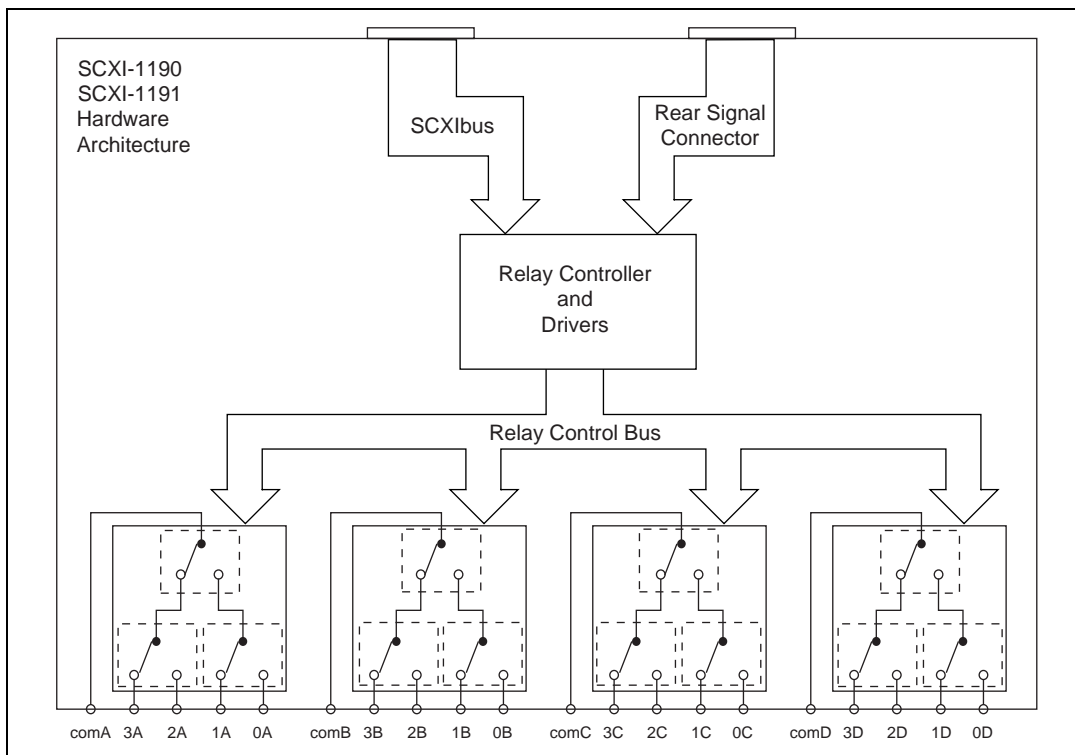


Figure 2-1. SCXI-119X Module Block Diagram

## Safety Instructions



**Cautions** *Do not operate damaged equipment.* The safety protection features built into this instrument can become impaired if the instrument becomes damaged in any way. If the instrument is damaged, do *not* use it until service-trained personnel can check its safety. If necessary, return the instrument to National Instruments for service and repair to ensure that its safety is not compromised.

Do *not* operate this instrument in a manner that contradicts the information specified in this document. Misuse of this instrument could result in a shock hazard.

*Do not substitute parts or modify equipment.* Because of the danger of introducing additional hazards, do *not* install unauthorized parts or modify the instrument. Return the instrument to National Instruments for service and repair to ensure that its safety is not compromised.



Connections that exceed any of the maximum signal ratings on the SCXI-119X can create a shock or fire hazard or can damage any or all of the devices connected to the SCXI-119X. National Instruments is *not* liable for any damages or injuries resulting from incorrect signal connections.

Clean the instrument and accessories by brushing off light dust with a soft, nonmetallic brush. Remove other contaminants with a stiff nonmetallic brush. The unit must be completely dry and free from contaminants before returning to service.

## RF Switching Precautions

---

The SCXI-119X is a *reflective switch*, meaning that any channels not switched to the common channel are unterminated, and any signal on an unterminated channel is reflected to its source. For most low-power switching applications this reflection is not a problem. However, operation with an unterminated output can damage some high-power RF sources. Consult your RF source documentation for more information about connecting to unterminated channels.



**Warning** Do *not* exceed the channel-to-ground rating of 24 V on the SCXI-1190 and 30 V<sub>rms</sub> or DC for the SCXI-1191. Any connections that exceed the maximum voltage for the SCXI-119X can result in an electrical shock hazard and damage to the switch module and any or all of the modules connected to the SCXI backplane. National Instruments is *not* liable for any damages or injuries resulting from exceeding maximum voltage ratings. Refer to Appendix A, *Specifications*, for specific information.



**Caution** Always disconnect all signals from the front connectors and power down the SCXI chassis before removing the SCXI-119X from the chassis. Observe electrostatic discharge handling precautions during and after removal of the module, or when connecting and disconnecting signals on the front panel.

## Contact Protection

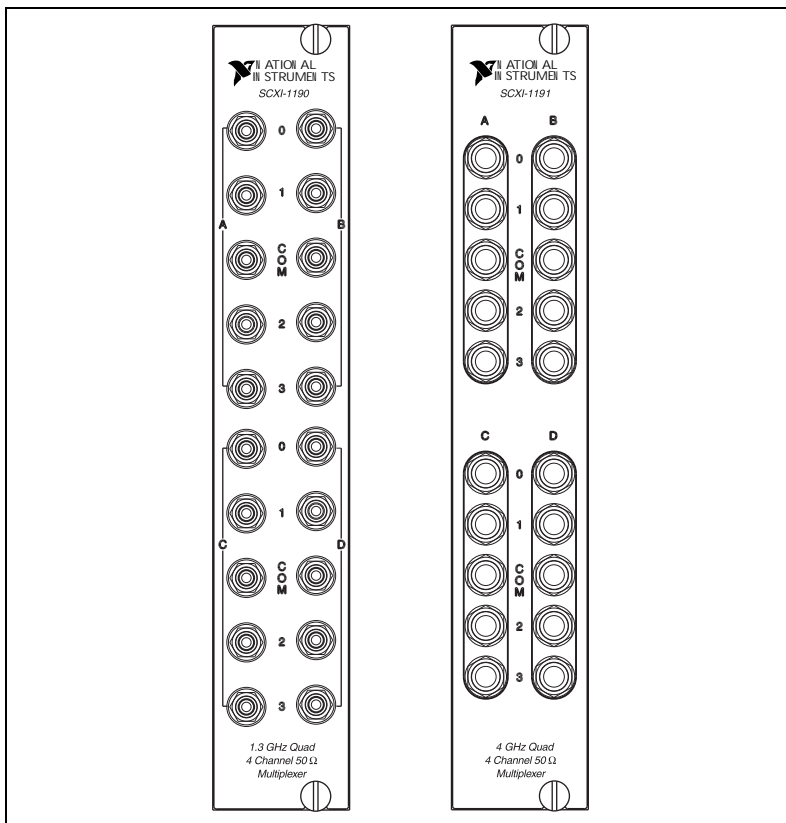
---



**Caution** The contacts of the relay are rated for a life of  $5 \times 10^6$  mechanical operations when operated with no signal or a very small signal present. At full rated power of 1 A at 24 VDC for the SCXI-1190 or of 30 VDC at 1/3 ADC for the SCXI-1191, the life of the switch is downgraded to 100,000 operations. If your setup allows, it is always best to turn off the input signals connected to the switch module during the switching operation to avoid contact arcing within the switch. Switching large inductive loads can also cause contact arcing. In such instances, install a flyback diode or varistor across the inductance to protect the switch.

## Connecting Signals

The SCXI-1190 has push-on SMB connectors, and the SCXI-1191 has screw-on SMA connectors as shown in Figure 2-2.



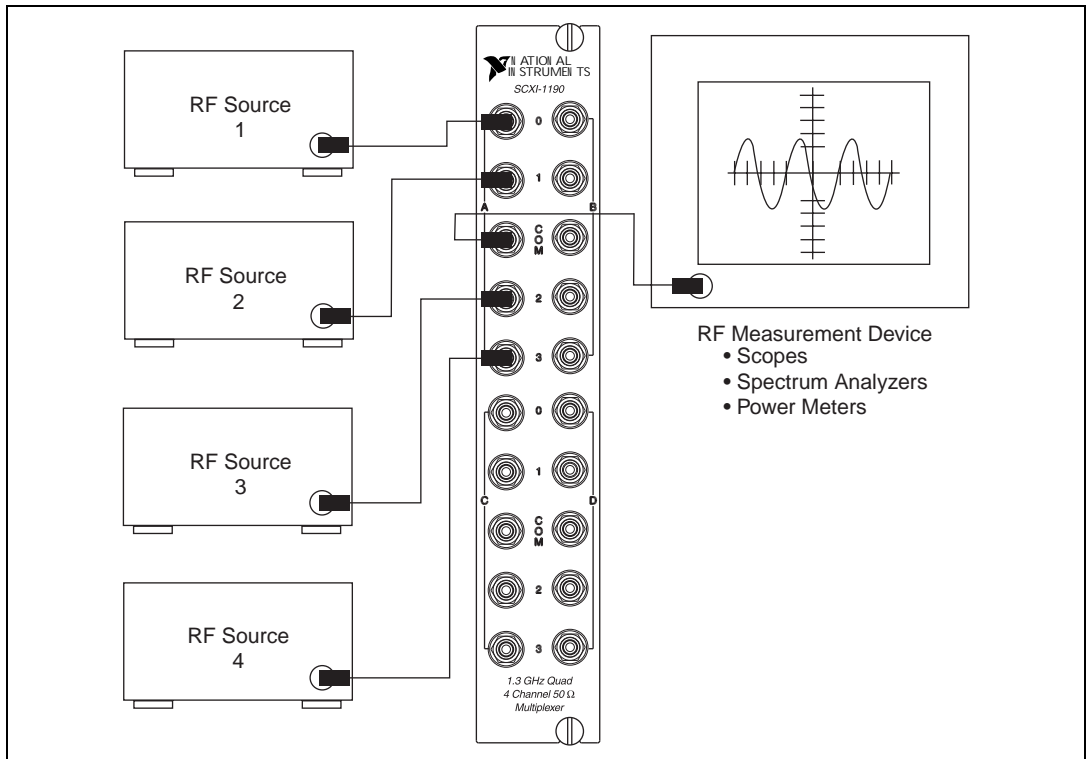
**Figure 2-2.** SCXI-1190 SMB Connectors, SCXI-1191 SMA Connectors



**Note** The power-up and reset state of the different multiplexer banks are as follows: banks A and C, channel 0 is connected to the COM terminal; banks B and D, channel 3 is connected to the COM terminal.

## Multiplexing to RF Sources

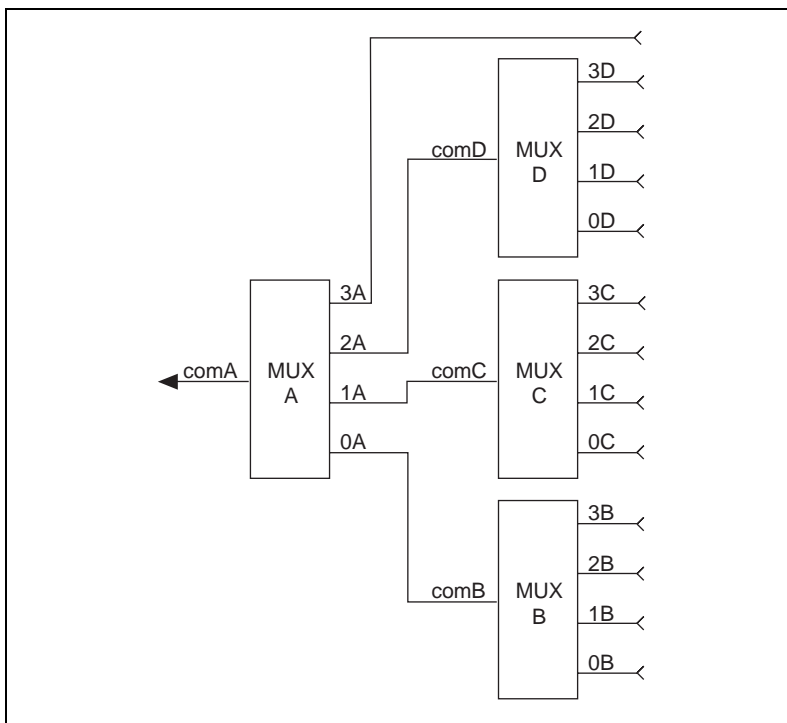
Figure 2-3 shows how to use the SCXI-119X to select one of four RF sources to be routed to a RF measurement device.



**Figure 2-3.** Connecting the SCXI-119X

## Expanding the RF Multiplexer

Figure 2-4 shows how to expand the SCXI-119X by cascading stages together. In the specific case of Figure 2-4, the module is used to create a 13 to 1 multiplexer with a two-stage architecture. You can cascade several modules to provide even larger multiplexers. Cascading multiplexers increases insertion loss, creates propagation delays, and may have other RF effects.



**Figure 2-4.** Expanding the SCXI-119X

---

# Specifications

This appendix lists the specifications for the SCXI-1190 and the SCXI-1191 multiplexer modules. These specifications are typical at 25 °C unless otherwise noted.

## SCXI-1190

---

### Input Characteristics

Number of relays per bank.....	3
Number of banks.....	4
Common-mode voltage	
Channel to earth.....	24 VDC
Maximum switching voltage	
AC.....	24 V <sub>rms</sub>
DC.....	24 VDC
Maximum switching capacity per channel	
DC.....	1 A at 24 V
AC.....	1 A <sub>rms</sub> at 24 V
Maximum switching power per channel .....	24 W
Contact on resistance (initial) .....	100 mΩ max
Contact material .....	Gold-clad silver

## RF Performance Characteristics

Characteristic impedance ( $Z_0$ ) .....50  $\Omega$

Insertion loss at:

$\leq 100$  MHz.....<0.4 dB  
 $\leq 500$  MHz.....<0.9 dB  
 $\leq 1.3$  GHz .....<1.5 dB  
 $\leq 2$  GHz .....<3 dB

VSWR at:

$\leq 100$  MHz.....<1.15  
 $\leq 500$  MHz.....<1.35  
 $\leq 1.3$  GHz .....<1.5  
 $\leq 2$  GHz .....<2.5 dB

Isolation:

$\leq 500$  MHz.....<-62 dB  
 $\leq 1.3$  GHz .....<-50 dB  
 $\leq 2$  GHz .....<-30 dB

Rise time .....<300 ps

Signal delay .....<3 ns

Maximum RF carry power

at 900 MHz.....10 W



**Note** Refer to the cautions and warning in Chapter 2, *Using the SCXI-119X*, for important information about using your SCXI-1190 with high-power signals.

## Dynamic Characteristics

Relay operate time (at 20 °C)

Typical.....15 ms

Relay release time (at 20 °C)

Typical.....15 ms

Expected life

Mechanical (no load)..... $5 \times 10^6$  operations

Electrical at maximum

switching capacity ..... $10^5$  operations



**Caution** Exceeding the maximum switching capability will decrease the expected life of the SCXI-1190.

## Power Requirement

+5 VDC

Maximum (all relays closed) ..... 600 mA

## Physical

Dimensions..... 17.30 by 19.56 by 3.02 cm  
(6.81 by 7.70 by 1.19 in.)

I/O connector..... 5 SMB female per bank

## Environment

Operating temperature .....0 to 50 °C

Storage temperature.....-20 to 70 °C

Relative humidity ..... 5% to 85% noncondensing

Electromagnetic compatibility

(EMC) emissions ..... Refer to the document supplied  
with the chassis for compliance to  
relevant directives.

EMI ..... FCC Class A compliant

## Certifications and Compliances

### CE Mark Compliance

See the Declaration of Conformity sheet accompanying product.

# SCXI-1191

---

## Input Characteristics

Number of relays per bank .....	3
Number of banks .....	4
Common-mode voltage	
Channel to earth.....	30 V <sub>rms</sub> or DC
Maximum switching voltage	
AC.....	30 V <sub>rms</sub>
DC.....	30 VDC
Maximum switching capacity per channel	
DC.....	30 VDC at 0.33 ADC
AC.....	30 V <sub>rms</sub> at 0.33 A <sub>rms</sub>
Maximum switching power per channel.....	10 W
Contact on resistance (initial) .....	200 mΩ max
Contact material.....	Gold

## RF Performance Characteristics

Characteristic impedance ( $Z_0$ ) .....	50 Ω
Insertion loss at:	
< 2.5 GHz .....	< 0.6 dB
< 4 GHz .....	< 0.9 dB
VSWR at:	
< 2.5 GHz .....	< 1.3
< 4 GHz .....	< 1.5
Isolation:	
< 2.5 GHz .....	< -60 dB
< 4 GHz .....	< -55 dB
Maximum RF carry power	
at 900 MHz.....	10 W





**Note** Refer to the warning and cautions in Chapter 2, *Using the SCXI-119X*, for important information about using your SCXI-1191 with high-power signals.

## Dynamic Characteristics

Relay operate time (at 20 °C)	
Typical .....	15 ms
Relay release time (at 20 °C)	
Typical .....	15 ms
Expected life	
Mechanical (no load) .....	$5 \times 10^6$ operations
Electrical at maximum switching capacity.....	$10^5$ operations



**Caution** Exceeding the maximum switching capability will decrease the expected life of the SCXI-1191.

## Power Requirement

+5 VDC	
Maximum (all relays closed) .....	950 mW

## Physical

Dimensions.....	17.30 by 19.56 by 3.02 cm (6.81 by 7.70 by 1.19 in.)
I/O connector.....	5 SMA female per bank

## Environment

Operating temperature .....	0 to 50 °C
Storage temperature.....	-20 to 70 °C
Relative humidity .....	5% to 85% noncondensing
Electromagnetic compatibility	
(EMC) emissions .....	Refer to the document supplied with the chassis for compliance to relevant directives.
EMI .....	FCC Class A compliant

## **Certifications and Compliances**

### **CE Mark Compliance (€)**

See the Declaration of Conformity sheet accompanying product.

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## Common Questions

This appendix addresses common questions you may have while using your SCXI-119X multiplexer module.

### **The SCXI-1190 is listed to have a 1.3 GHz bandwidth. Can I use it at 2 GHz bandwidth?**

The SCXI-1190 can definitely be used at 2 GHz, as long as the isolation, VSWR, and attenuation levels are acceptable for your particular application. Refer to Appendix A, *Specifications*, for a complete list of the parameters at 2 GHz.

### **What should I do if the software detects the module but the switches do not switch?**

- Verify that the switches do not switch by trying to close and open the switches. You can verify the switches' functionality by using the NI-SWITCH front panel. Access the front panel by clicking on **Start>Programs>National Instruments Switch>NI-Switch Soft Front Panel**.
- Also be sure to check the return codes of the NI-SWITCH operation to ensure that there are no errors (negative value) or warnings (positive value).
- Finally, verify that your code is correct. For reference, see the examples described in the *NI-SWITCH Software User Manual*. The NI-SWITCH driver ships with several examples in source code. Compare your algorithm to those in the examples.

### **Do I need to program the switch module myself?**

The SCXI-119X comes with the NI-SWITCH driver software, which exports the full functionality of the module. NI-SWITCH handles the complex issues of direct memory access, interrupts, and operating system interfacing for you. All you need to do is make high-level calls to these functions from your ADE.

**One of my modules doesn't switch properly anymore. What's wrong?**

One of the relays has probably worn out. Relays are mechanical devices and have a limited switching lifetime. Call National Instruments for information on replacing your relays.

**What is VSWR, and how does it affect my system?**

VSWR stands for Voltage Standing Wave Ratio; it is a measure of the reflection on a transmission line. The percentage of a signal reflected back to the source is equal to  $(VSWR-1)/(VSWR+1)$ . This means that a VSWR of 1 is optimum, with no reflected signal. On higher power applications, a large VSWR can damage the output stage of the source. High VSWR also means that a large percentage of the power from the source cannot be delivered to the load.

**What is isolation, and why is it important?**

*Isolation* is a measure of the amount of cross-talk between channels. For example, if a 1 Vp-p signal is isolated by 40 dB to another channel, then 10 mVp-p will be seen on the adjacent channel (in addition to the signal already on the channel).

---

# Technical Support Resources

This appendix describes the comprehensive resources available to you in the Technical Support section of the National Instruments Web site and provides technical support telephone numbers for you to use if you have trouble connecting to our Web site or if you do not have internet access.

## NI Web Support

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To provide you with immediate answers and solutions 24 hours a day, 365 days a year, National Instruments maintains extensive online technical support resources. They are available to you at no cost, are updated daily, and can be found in the Technical Support section of our Web site at [www.ni.com/support](http://www.ni.com/support)

### Online Problem-Solving and Diagnostic Resources

- **KnowledgeBase**—A searchable database containing thousands of frequently asked questions (FAQs) and their corresponding answers or solutions, including special sections devoted to our newest products. The database is updated daily in response to new customer experiences and feedback.
- **Troubleshooting Wizards**—Step-by-step guides lead you through common problems and answer questions about our entire product line. Wizards include screen shots that illustrate the steps being described and provide detailed information ranging from simple getting started instructions to advanced topics.
- **Product Manuals**—A comprehensive, searchable library of the latest editions of National Instruments hardware and software product manuals.
- **Hardware Reference Database**—A searchable database containing brief hardware descriptions, mechanical drawings, and helpful images of jumper settings and connector pinouts.
- **Application Notes**—A library with more than 100 short papers addressing specific topics such as creating and calling DLLs, developing your own instrument driver software, and porting applications between platforms and operating systems.

## Software-Related Resources

- **Instrument Driver Network**—A library with hundreds of instrument drivers for control of standalone instruments via GPIB, VXI, or serial interfaces. You also can submit a request for a particular instrument driver if it does not already appear in the library.
- **Example Programs Database**—A database with numerous, non-shipping example programs for National Instruments programming environments. You can use them to complement the example programs that are already included with National Instruments products.
- **Software Library**—A library with updates and patches to application software, links to the latest versions of driver software for National Instruments hardware products, and utility routines.

## Worldwide Support

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National Instruments has offices located around the globe. Many branch offices maintain a Web site to provide information on local services. You can access these Web sites from [www.ni.com/worldwide](http://www.ni.com/worldwide)

If you have trouble connecting to our Web site, please contact your local National Instruments office or the source from which you purchased your National Instruments product(s) to obtain support.

For telephone support in the United States, dial 512 795 8248. For telephone support outside the United States, contact your local branch office:

Australia 03 9879 5166, Austria 0662 45 79 90 0, Belgium 02 757 00 20,  
Brazil 011 284 5011, Canada (Calgary) 403 274 9391,  
Canada (Ontario) 905 785 0085, Canada (Québec) 514 694 8521,  
China 0755 3904939, Denmark 45 76 26 00, Finland 09 725 725 11,  
France 01 48 14 24 24, Germany 089 741 31 30, Greece 30 1 42 96 427,  
Hong Kong 2645 3186, India 91805275406, Israel 03 6120092,  
Italy 02 413091, Japan 03 5472 2970, Korea 02 596 7456,  
Mexico (D.F.) 5 280 7625, Mexico (Monterrey) 8 357 7695,  
Netherlands 0348 433466, New Zealand 09 914 0488,  
Norway 32 27 73 00, Poland 0 22 528 94 06, Portugal 351 1 726 9011,  
Singapore 2265886, Spain 91 640 0085, Sweden 08 587 895 00,  
Switzerland 056 200 51 51, Taiwan 02 2528 7227,  
United Kingdom 01635 523545

# Glossary

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Prefix	Meanings	Value
n-	nano-	$10^{-9}$
m-	milli-	$10^{-3}$
M-	mega-	$10^6$
G-	giga-	$10^9$

## Symbols

° degrees

Ω ohms

% percent

## A

A amperes

AC alternating current

ADE application development environment such as LabVIEW, LabWindows/CVI, Visual Basic, and C or C++

## C

C Celsius

channel pin or wire lead on the multiplexer to which you apply or from which you read the analog or digital signal. Signals can be single-ended or differential.

## D

DAQ data acquisition

dB	decibel
DC	direct current
device	a plug-in board, card, or pad that can contain multiple channels and conversion devices. Some examples of devices are computers, multimeters, multiplexers, oscillators, operator interfaces, and counters.
digital multimeter	a multifunction meter used to make measurements such as voltage, current, resistance frequency, temperature, and so on
DMM	<i>See</i> digital multimeter
drivers/driver software	software that controls a specific hardware device such as a switch card
<b>G</b>	
g	gram
<b>H</b>	
Hz	hertz—the number of scans read or updates written per second
<b>I</b>	
isolation	a measure of the amount of cross-talk between channels
IVI	Interchangeable Visual Instrument
in.	inches
<b>M</b>	
m	meter
MB	megabytes of memory
multiplexer	a switching device with multiple inputs that sequentially connects each of its inputs to its output, typically at high speeds, in order to measure several signals with a single analog input channel



**N**

NI-SWITCH                    an IVI-based instrument driver that supports the National Instruments line of switch cards

**O**

oz                              ounce

**P**

PXI                            PCI with extensions for instrumentation

**R**

RF                            radio frequency

relay                        a switch that connects or disconnects the signal to a common through the physical movement of a metal arm

rms                          root mean square—the square root of the average value of the square of the instantaneous signal amplitude; a measure of signal amplitude

**S**

s                              seconds

SCXI                        Signal Conditioning eXtensions for Instrumentation—the National Instruments product line for conditioning low-level signals within an external chassis near sensors so only high-level signals are sent to DAQ boards in the noisy PC environment

*Glossary*

**V**

V volts

VDC volts, direct current

VSWR Voltage Standing Wave Ratio

**W**

W watts

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